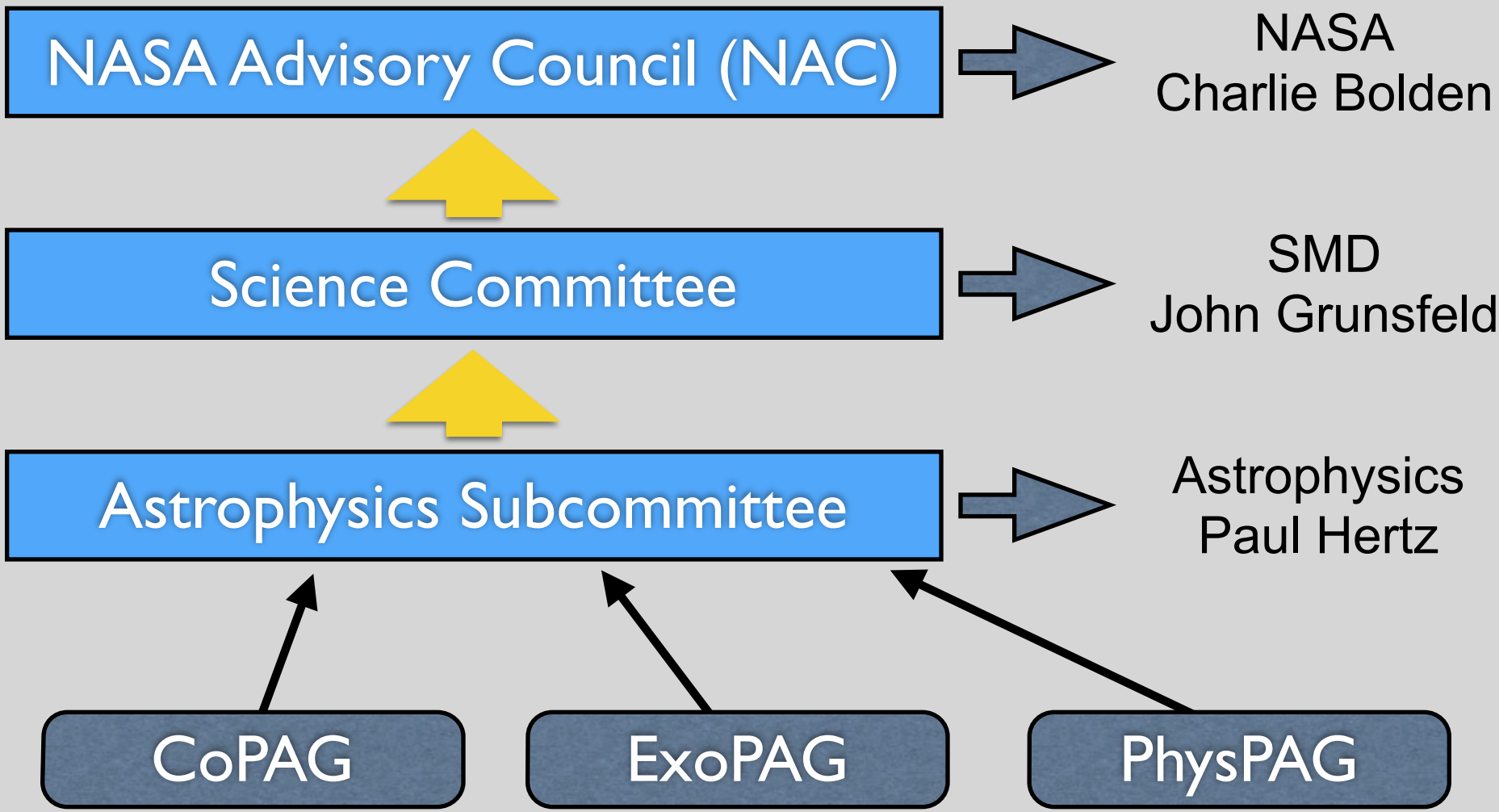
What's Next?

Mark McConnell
University of New Hampshire

- NASA Advisory Structure
- 2020 Decadal Survey
- Gamma-Ray Community Roadmap
- Discussion

NASA Advisory Structure



Program Analysis Groups (PAGs)

CoPAG	Cosmic Origins	Explore the origin and evolution of the galaxies, stars and planets that make up our universe.	cor.gsfc.nasa.gov
ExoPAG	Exoplanet Exploration	Discover and study planets around other stars, and explore whether they could harbor life.	exep.jpl.nasa.gov
PhysPAG	Physics of the Cosmos	Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity.	pcos.gsfc.nasa.gov

PhysPAG

Physics of the Cosmos Program Analysis Group

Science Interest Group	Description	Website
IPSIG	Inflation Probe (CMB)	pcos.gsfc.nasa.gov/sigs/ipsig.php
GWSIG	Gravitational Wave	pcos.gsfc.nasa.gov/sigs/gwsig.php
XRSIG	X-Rays	pcos.gsfc.nasa.gov/sigs/xrsig.php
GammaSIG	**Gamma Rays**	**pcos.gsfc.nasa.gov/sigs/gammasig.php**
CosmicSIG	Cosmic Rays	pcos.gsfc.nasa.gov/sigs/cosmicsig.php

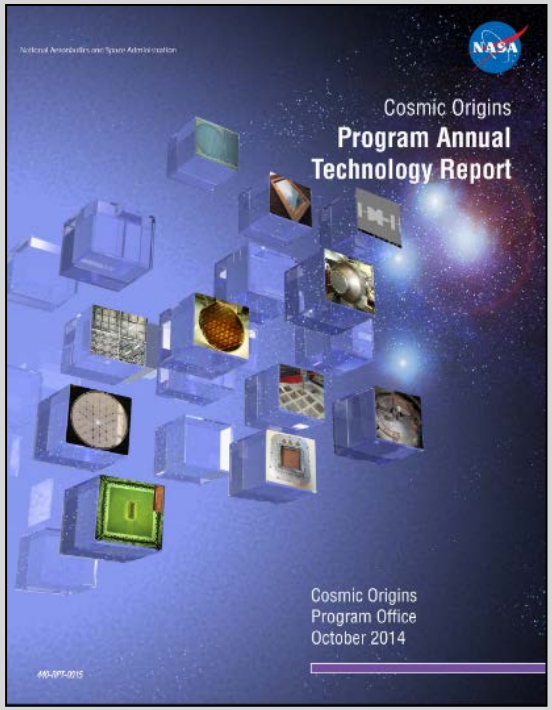
Strategic Documents

http://science.nasa.gov/astrophysics/documents

Associated Technology Documents

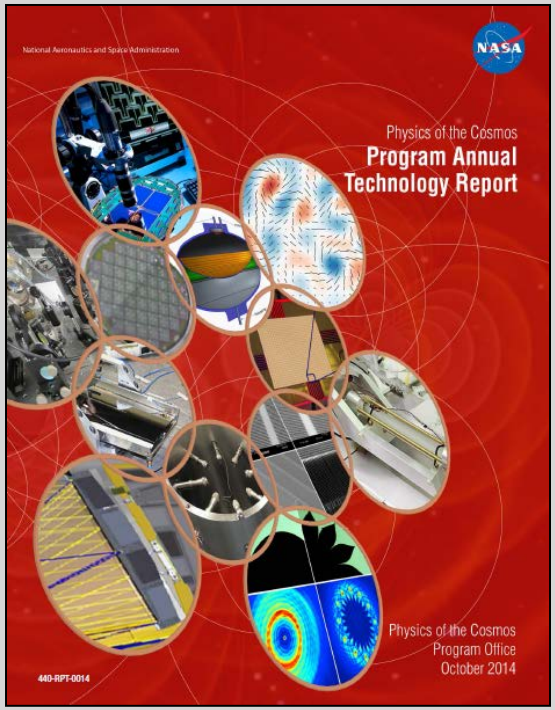
NASA's Astrophysics Division supports technology developments enabling and enhancing efforts to discover how the universe works, explore how it began and evolved, and search for life on planets around other stars

Cosmic Origins (COR)
Explore the origin and evolution of the galaxies, stars and planets that make up our universe



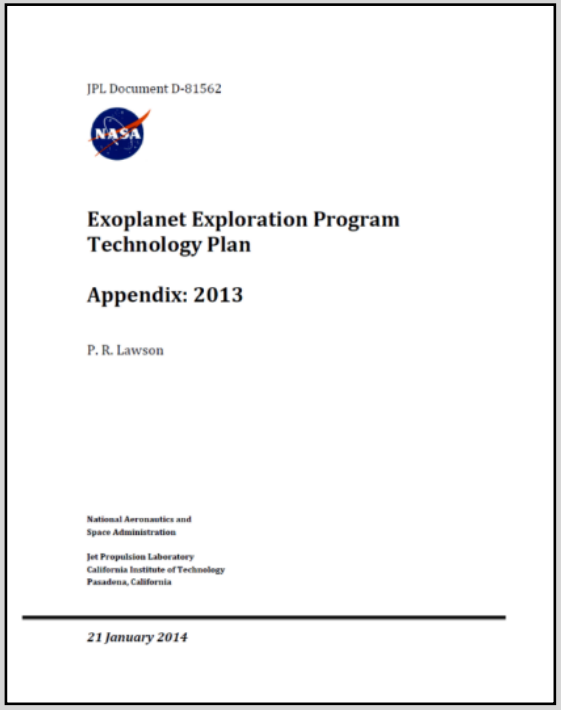
cor.gsfc.nasa.gov

Physics of the Cosmos (PCOS)
Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity



pcos.gsfc.nasa.gov

ExoPlanet Exploration (ExEP)
Discover and study planets around other stars, and explore whether they could harbor life



exep.jpl.nasa.gov

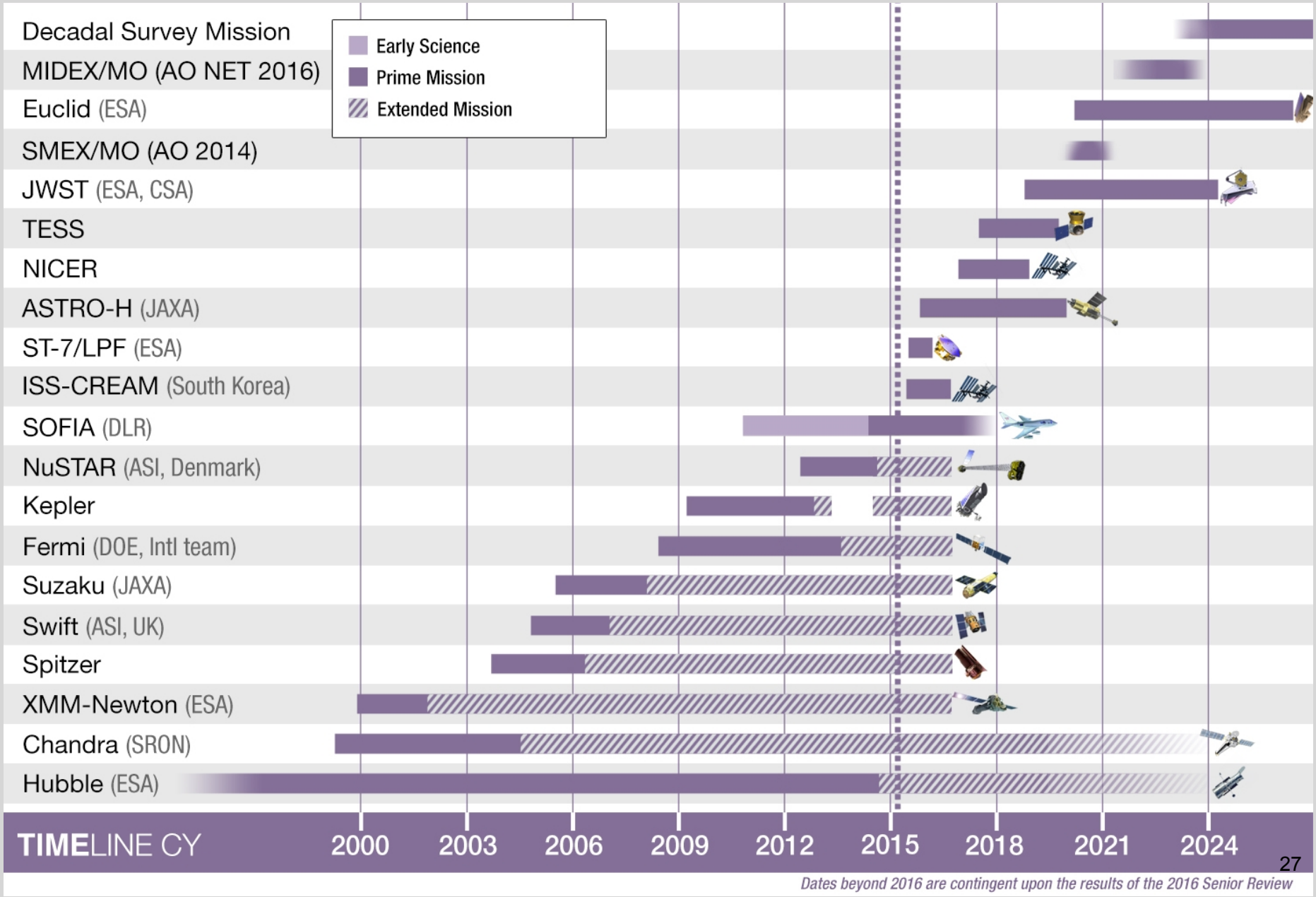
Gamma Ray Technology in 2014 PATR

Table 3-1. Technology Gaps Evaluated by TMB in 2014 (continued)	
Name of Technology	**High-performance gamma-ray telescope**
Description	Two technologies are needed to enable gaseous detectors, *e.g.*, Time Projection Chambers (TPC), with large volumes, 10s to 100s of m^3, to be inflated on orbit: 1) The inflatable pressure shell must contain the detector gas at pressures up to ~3 atm, be capable of self-sealing against micro-meteors, and have a surface density of <1 g/cm^2. The TPC field-shaping electrodes are mounted on the inner surface of the inflatable shell and deploy as the shell inflates to positions accurate to ~1 mm. 2) The TPC readout structure at the bottom of the TPC must unfold within the gas volume, be rigid, and have position accuracy of ~1 mm.
Current State of the Art	Thin Red Line Aerospace developed and supplied 20 full-fidelity inflatable pressure shells of up to 320 m^3 volume for Bigelow Aerospace inflatable habitat Genesis spacecraft flight hardware. Thin Red Line designed, engineered, and manufactured the pressure-restraining hulls of Genesis 1 and 2 (launched 7/2006 and 6/2007, respectively), the first spacecraft on orbit successfully incorporating large-volume, high-stress inflatable architecture. See http://www.thin-red-line.com/projects.html for other projects. Large deployable mirrors have been developed for JWST. This technology could be adapted for the deployable TPC readout.
Current TRL	6
Performance Goals and Objectives	The goal is to enable construction of a ~100 m^3 gamma-ray pair telescope with arc-minute angular resolution and continuum sensitivity of better than 5×10^{-7} between ~100 MeV and ~10 GeV. The objectives can be met by demonstrating an inflatable TPC gas shell with volume ~10 m^3 at ~1 atm and deployable readout electrodes with area of ~2 m^2.
Scientific, Engineering, and/or Programmatic Benefits	Inflatable gaseous detectors would enable gamma-ray telescopes to achieve arc-minute angular resolution. Deployable 2D readout structures within a large gas volume would increase telescope sensitivity.
PCOS Applications and Potential Relevant Missions	Arc-minute gamma-ray telescope.
Time to Anticipated Need	Demonstration at TRL 3-4 by release of FY16-17 Explorer AO. TRL 6+ a few years later, before launch of Explorer.

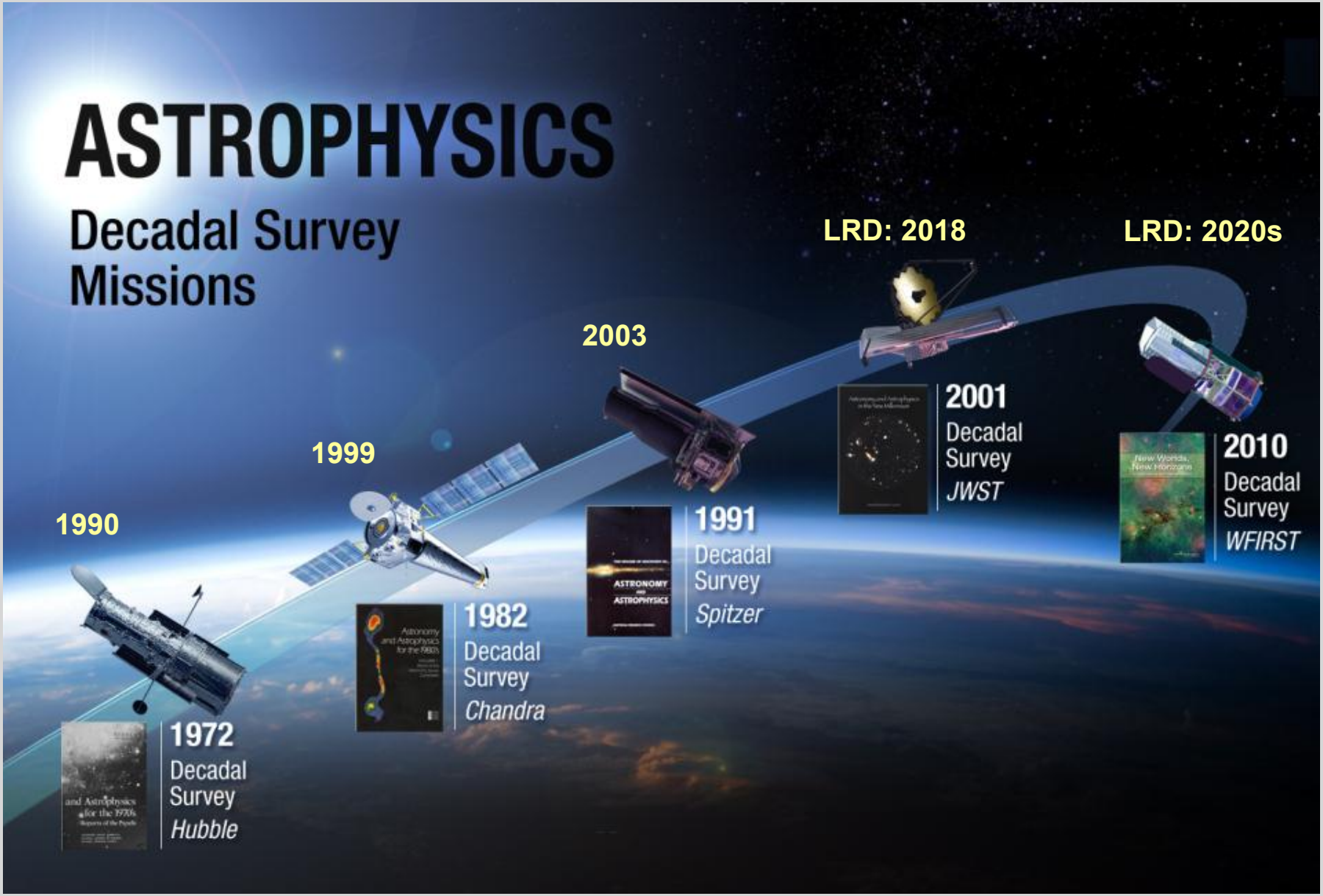
Mission Classes

- **Flagship (Large) Missions (> $1B)**
- **Probe (Medium) Missions (< $1B)**
- Explorers
  - MIDEX (< $250M)
  - SMEX (< $125M)
- Cubesats ($2-10M)
- Balloons ($2-10M)

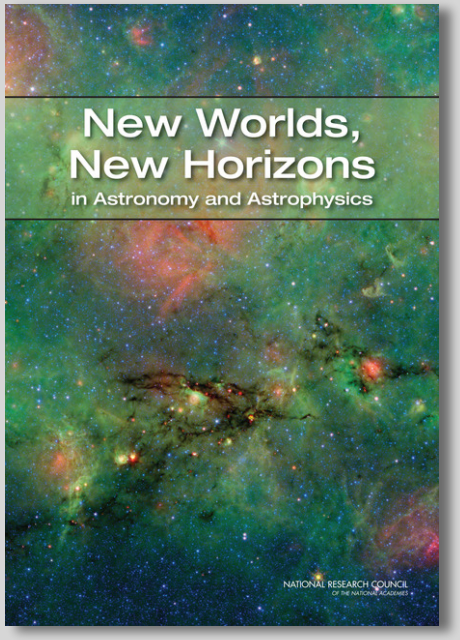
Astrophysics Missions



Large-Scale Missions



2010 Decadal Survey

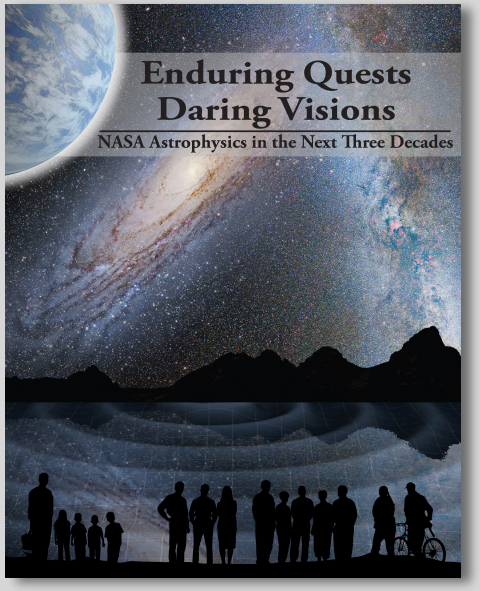


New Worlds, New Horizons
in Astronomy and Astrophysics

10 year plan released in August of 2010.

- 324 white papers were submitted from the astronomical community.
- Many of these were submitted from the gamma-ray community.

2013 Astrophysics Survey



Enduring Quests, Daring Visions
NASA Astrophysics in the Next Three Decades

Roughly 120 abstracts were submitted (in total), out of which three gamma-ray presentations were selected for an on-line workshop.

1) Particle Acceleration and MeV astronomy – Explosion physics with Type I SNe
(Eric Grove)

2) Understanding Black Holes with X-ray and Gamma-Ray Polarimetry
(Jeremy Schnittman)

3) Technology Development for X-ray and Gamma-Ray Polarimetry
(Mark McConnell)

2020 Decadal Survey

Preparations for 2020 Decadal Survey

- The NASA Authorization Act of 2005 requires assessments of NASA's science programs that include mid-decade reviews.
- The Astrophysics Mid-decade Review will take place in 2015-2016.
- The next decadal survey will likely identify 1-2 large missions for post-JWST/WFIRST implementation
- In support of this effort, NASA intends to study a small number (3-4) of candidate large mission concepts.

Large Mission Concept Studies

NASA Astrophysics Director Paul Hertz charged the three PAGs to write a report (due ~August) recommending 3-4 large space mission concepts.

NASA plans to set up a Science & Technology Development Team (STDT) for each concept, with funding sufficient to develop the science case and necessary engineering & costing required for a full Decadal submission. Although the reports are to focus on Large missions, he also invited the PAGs to include appendices, at their discretion, discussing Medium class ("Probe") missions at the <$1B level.

Baseline Concepts

NASA has identified four large missions to serve as a baseline for mission concept studies:

- Far IR Surveyor
- Habitable-Exoplanet Imaging Mission
- UV/Optical/IR Surveyor
- X-ray Surveyor

Timeline For Large Mission Inputs

November 2014	Discussion of this plan with the Astrophysics Subcommittee and the Committee on Astronomy and Astrophysics
December 2014	Presentation of this plan to the Executive Committees of the PAGs
January 2015	Announcement of this process to the PAGs, including formal charges, in a joint PAG meeting prior to the AAS meeting in Seattle
January 2015 – Summer 2015	Community discussion and input led by the PAG Executive Committees. Each PAG will determine an appropriate process for community discussion and input. The PAG process will include input from the broad astronomical community, optionally including open meeting(s) of the PAG. Each PAG will develop a public report for submission to the NAC Astrophysics Subcommittee.
Fall 2015	Meeting of the NAC Astrophysics Subcommittee to consider the three PAG reports and report to NASA on a small setof large mission concepts for study.
Fall 2015	Decision by the Astrophysics Division Director identifying the small set of candidate large mission concepts that will be studied by NASA as input for the 2020 Decadal Survey.

Medium Class Mission Inputs

Probe-class (medium size) mission concepts

- No decision has been made by NASA at this time on how to provide input to the 2020 Decadal Survey Committee regarding probe-class missions.
- There are multiple paths to identifying probe-class mission concepts, and none have been precluded at this time.
- Each of the STDTs for large mission concepts will be challenged to identify one or more probe-class versions of their mission and to estimate the percentage of the original science case that can be achieved.
- The Mid-Decade Review may provide recommendations to NASA regarding the value of probe-class mission concept studies in advance of the 2020 Decadal Survey.
- Should NASA conduct stand-alone probe-class mission concept studies, they would be initiated no earlier than FY2017.

Special HEAD Meeting

High Energy Large and Medium-class Space Missions in the 2020s

June 29 - July 1, Chicago

This meeting offers the HEAD community an opportunity to gather and provide input to the PhysPAG, CoPAG, and ExoPAG regarding high-energy large mission concepts and probe class missions. The meeting will include invited talks covering HEAD-related large mission concepts along with overviews of HEAD science goals for the 2020s. Contributed talks & posters regarding the science and/or technology of probe-class missions will also be accepted. Time will be set aside for splinter meetings as well, including likely XRSIG, GWSIG, GammaSIG, and CosmicSIG meetings. All presenters will be asked to provide a short (1-2 page) written contribution, due before the meeting, that will constitute the proceedings of the meetings. This will also be provided to the PhysPAG, CoPAG, and ExoPAG Executive Committees for their consideration when drafting their reports.